

# Hospital Ships, Trains, and Aircraft

Patrick H. Stakem

(c) 2020

**Table of Contents**

Author.....4  
 Introduction.....4  
 Early Hospital Ships.....5  
     USS Comfort & her Sisters.....8  
     Hospital ships of the U. S. Army.....10  
     Hospital ships of the U. S. Navy.....11  
     Other Country's Hospital ships.....11  
     The United States Civil War Hospital Ships.....13  
         Red Rover.....13  
     U. S. Sanitary Commission.....17  
     War in the North.....17  
 Ambulance Trains.....18  
     Hospital Trains in World War-I.....19  
 Medical Air Transport.....22  
 Afterword.....24  
 Glossary of Terms.....25  
 References.....27  
 Resources.....33  
 If you enjoyed this book, you might also be interested in some of  
 these.....36

“Military hospital ships, that is to say, ships built or equipped by the Powers specially and solely with a view to assisting the wounded, sick and shipwrecked, to treating them and to transporting them, may in no circumstances be attacked or captured, but shall at all times be respected and protected, on condition that their names and descriptions have been notified to the Parties to the conflict ten days before those ships are employed.”

International Committee of the Red Cross, Convention for the Amelioration of the Condition of Wounded, Sick, and Shipwrecked Members of Armed Forces at Sea. Geneva, 12 August 1949.

## **Author**

Mr. Patrick H. Stakem tripped across the topic of hospital ships researching for information on the Riverine ironclad ships of the American Civil War. From there, the topic lead to train evacuation of the wounded, hospital trains, and today's flying hospitals. Fascinating topic, and very applicable today.

## **Introduction**

This book touches on Hospital Ships, Trains and Aircraft, to provide transportation and treatment of the wounded. An outgrowth of this has been Hospital Ships, Trains, and Planes to provide humanitarian aid, and to serve as teaching hospitals for complex procedures. There is some evidence of ancient Greek and Roman Hospital ships, based on the Ships' names, *Therpia* and *Aesculapius*, but no further information is known.

This is not a complete compilation of all hospital ships, trains, and planes that have served, but it does try to hit on the highlights, and follows the development and improvement of these lifesavers.

As this is being written, we see the Military involvement in the response to the Corona Virus epidemic, both in the deployment of

the Navy's Hospital ships, but also the deployment of Army forces to convert facility's to field hospitals, and to deploy field hospitals in major city's and rural areas.

## Early Hospital Ships

The British began using hospital ships in the 1600's accompanying Royal Navy vessels. This was short-lived, but re-instituted in mid-17<sup>th</sup> Century. There were two official Navy Hospital ships, and numerous civilian merchant vessels were employed. Typically, the medical staff was a surgeon and four surgeon's mates. They mostly catered to the sick as opposed to the wounded.

HMHS *Goodwill* was part of a Royal Navy Squadron in the Mediterranean around 1608. By 1665, the Royal Navy maintained two hospital ships. By the Nine Years War (1688-1697) France vs. Holy Roman Empire, including Britain, there were eventually 6 ships. These, contrary to current practice, were armed.

When General Braddock set sail for the American Colony's to push back the French in what is called the French and Indian War of 1754-63, he had 2 Regiments of Foot on 13 troop transports of the Royal Navy. He also had the HMS *London*, the assigned transport for the Medical Officers, headed by James Napier. The *Neptune* was the Medical stores ship. He landed in Alexandria, Colony of Virginia, and traveled to Fort Cumberland, in Western Maryland. From there he marched his troops and cannon to Fort Duquesne, at the current location of the City of Pittsburg. Once that was taken, he was to march on to Quebec, and kick the French out. But, at Fort Duquesne, things went very badly. Braddock's force was about 1,300 men. He was not quite up to speed on the Native American method of warfare. Large numbers of the British were killed and wounded, and Braddock himself was killed. The men retreated in a panic, leaving more than 450 dead, with 422 wounded walking back as well they could. Braddock had left his wagons behind at a base camp. The wounded who survived and got that far were put in the wagons to be taken back to Fort

Cumberland. That was the closest medical care, more than 100 miles away.

Fort Cumberland needed a large new cemetery, which was located west of the Fort. Casualty Lists are in the Cumberland Papers at Windsor Castle. The surgeons mentioned that many of the fatalities were caused by “friendly fire.” This observation was due to the fact that caliber of the ammunition removed from body's. The French and their Native American allies used a lighter musket with a smaller ball.

British Hospital ships served in the Boxer Rebellion (1899-1901) in China, and the Second Boer War (1899-1902) in Africa. Use of the ships was fairly unique among the European powers, augmenting sparse medical facility's on each fighting ship.

The British hospital ships *Unity* and *Welcome* evacuated sick soldiers and their family's from Tangier in 1683.

There was a recognized need for more medical personnel on board the ships. In the early 1700's, 6 surgical assistants were added, and four washer women. In 1705, four male nurses were added.

In 1798, the HMS *Victory*, Lord Nelson's flagship at the Battle of Trafalgar, was no longer fit for service, and was converted to a hospital ship for wounded French and Spanish prisoners of war. Ships were also used to quarantine plague victims. This was a common practice through 1970.

The Crimean War (1853-1856) drove the further development of hospital ships. There was only one military hospital for the British in the Dardanelles. The Siege of Sevastopol produced some 15,000 wounded. The focus began to shift from treating sick sailors, to handling vast numbers of army casualty's.

The Mexican-American War of 1846-1848 showed the inadequacy of the U.S.'s medical establishment. More soldiers died of disease

than enemy action. This would be vastly improved by the time of the American Civil War.

The British ships HMS *Melbourne* and HMS *Mauritius* were steamships equipped with what we would recognize as true medical facility's, including an operating theater. During the Russo-Turkish War of 1877-78, The British Red Cross Society provided a steel-hulled ship with a surgery with anesthetics (!) and antiseptics. Similar ships served in the British invasion of Egypt.

Royal Navy Hospitals were maintained at Malta, Gibraltar, South Africa, and Hong Kong, among other locations.

Both sides in the Russo-Japanese War of 1904-05 had hospital ships. The Russian Hospital ship *Orel* participated. The Russians suffered nearly 4,400 killed and more than 5,900 captured. They lost eleven of their battleships and most of their smaller warships.

British hospital ships aided the U.S. in the Spanish-American war. The *USS Solace* and *USS Relief* served during the war, after being converted from passenger liners.

*Britannic*, a sister ship to *Titanic*, was converted to a hospital ship. The *USS Pawnee* served as a hospital ship from 1869 to 1882.

World War-I saw a massive use of hospital ships. Passenger liners were converted for hospital use. The Royal Navy had 77 ships in service. Two of these were sunk by Germany U-boats in direct opposition to the Rules of War. Firing on a clearly marked hospital ship is considered a war crime. Canada had six Naval hospital ships and ambulance transports in World War-1. Of these two were lost in action. The U.S. had its own group of hospitals ships, operated by the Navy. These included the *Comfort*, the *Mercy*, and the *Solace*.

In all some 26 hospital ships of most of the belligerents were sunk in World War-1. Some were torpedoed by submarines, and some

stuck floating mines. None were lost to surface action.

The United States built the USS *Relief* specifically as a hospital ship. It was laid down in 1917 at the Philadelphia Naval Yard, and launched in 1919. It had a capacity of 550 patients. In 1923, she relieved the USS *Mercy* as the hospital ship for the Pacific Fleet. In 1941, she departed the West Coast for the Navy Yard at Norfolk, Virginia. She served as a floating hospital for the Navy's Atlantic Fleet.

In more modern times, the British deployed four hospital ships in the Falklands War (1982).

In the current (2020) Corona Virus epidemic in the United States, the U. S. Navy, at the direction of the President, deployed the Hospital Ships, *Comfort* to New York and *Mercy* to Los Angeles. They were initially tasked with off-loading non-Corona Virus affected patients from the regular hospitals.

In a bizarre incident, an Engineer with the Pacific Harbor Rail Line attempted to ram the hospital ship. He didn't quite make it, and was arrested by the California Highway Patrol. There were no injuries, but there was spilled diesel fuel. The engineer was charged with the Federal crime of Train Wrecking, and faces 20 years in jail.

## **USS Comfort & her Sisters**

There have been three ships of this name. The current one is serving in New York City, to assist with the Corona Virus epidemic. Her sister ship, the *Mercy* is currently in New York Harbor. They are both converted supertankers of the San Clemente class. They have steam turbine engines, and can carry 1,000,000 gallons of fuel, giving a range of 13,500 Nautical miles. She produces her own oxygen on board for patient use, and distills fresh water from sea water in the amount of 300,000 gallons per day.

The first ship of the name served from 1917 until 1921. It was a

converted passenger liner, The SS *Havana*. The second served in World War-II, 1944 to 1946. The current one entered service in 1987.

The second *Comfort*, (AH-6) had been launched in 1943 with sister ships *Hope* and *Mercy*. *Comfort* had a Navy crew and an Army medical staff. She operated out of Hollandia, New Guinea, where a major Army medical facility had been built. She transported patients back to San Pedro, California. In Okinawa, she was struck by a Japanese Suicide plane. The plane went through three decks, and exploded in the surgery. Twenty-eight were killed. She had temporary repairs at Guam, and returned to Los Angeles. The comfort could handle 400 patients.

The *Comfort* was long stationed at Baltimore, MD, but was later transferred to Norfolk, near Naval Medical Center Norfolk.

The *Hope* was operated for the Army, by the Navy. She served in the Pacific. She had been attacked by torpedo planes and shadowed by a Japanese submarine. After her wartime service, she was decommissioned in 1946. She operated as a civilian hospital ship until 1974.

The *Mercy* was the second of that name, and was a converted a cargo ship. All three of the *Comfort* class ships were commissioned and crewed by the Navy, with Army medical staff. They were tasked with evacuation, stabilization of the patients, and transport. She served in the Philippines and Okinawa

In World War-II, the USAHS *Marigold*, of the 212<sup>th</sup> Hospital Ship Complement, could handle 758 patients. She served at Italy, and then went to the Pacific theater. She took aboard and cared for Allied soldiers that had been held captive by the Japanese. In all the roster of Army hospital ships numbered 30 vessels. The Navy operated 15 hospital ships and 3 ambulance ships.

As aerial evacuation was introduced, the role of the trains diminished. Practical helicopters provided rapid evacuation to MASH units safely back from the front lines. The Army also relied on the Quartermaster Corps for ships.

In World War-II, the U. S. Navy had 6 hospital ships of the *Haven* class. These could receive the wounded by helicopter. They served through the Vietnam war. The last ship of this class was retired in 1989.

## Hospital ships of the U. S. Army

The U. S. Army operated more than 30 Hospital Ships, starting with low-draft riverine ships in the Civil War. The Spanish-American War in the Philippines and World War-1, brought more vessels into play. For example, the USAHS *Algonquin* started out life as an Ocean liner, built at Newport News Shipyard. She was requisitioned for Army duty in 1940, initially as a troop transport, but later as a hospital ship. She was refitted at the Alabama Drydock and Shipbuilding Co. in Mobile. She served until 1946, and was scrapped in 1957. She mostly served in the European theater in World War-II.

The AH-5 Solace was at Pearl harbor during the Japanese attack, but was not damaged, and assisted the wounded.

The Army had 24 hospital ships with a total capacity of 17,000 patients. One example, the USAHS *Thistle*, was a 455 bed facility. Other units included USAHS Frances Y. Slinger and USAHS Acadia.

In the North African campaign, the U.S. Did not yet have Hospital Ships, so American wounded were transferred back the to States on British Ships. For the invasion of Sicily, the USAHS *Acadia* and *Seminole* were in service. The USAHS *Blanche F. Sigman* was named after an Army nurse killed at Anzio.

By the Battle of the Bulge, December, 1944, Air evacuation by C-54 *Skymaster* transports were routine. There could hold 49 seats, or 126 stretchers. They had a range of 4,000 miles, so they could get from Europe to the United States.

## **Hospital ships of the U. S. Navy**

The U.S. Navy has had Hospital ships since 1798. The first was the USS *Intrepid*, captured by the Navy in the First Barbary War (1801-05). She had been built for Napoleon's Navy, and later sold to Tripoli. She was captured by the schooner U.S.S. *Enterprise*, captained by Stephen Decatur, as it sailed from Tripoli to Constantinople.

Prior to the Geneva Conventions, the Navy had 6 hospital ships, through 1896. After the Conventions, the Navy has deployed 20, through 1920.

In World War-II, some Landing Ship, Tanks were used to return the sick and wounded from beaches. They were still armed, and not protected by the Geneva agreements. On D-day in France, 150 LST's returned more than 41,000 wounded. They had very limited facility's on board, with usually just two Navy Pharmacist mates. Later, in their Pacific service, a surgical team was included

For the planned invasion of Japan, 36 LST's were equipped with surgical teams and medical supply's for use at the beachhead. LST-464 was converted into a true hospital ship The tank deck was converted to a hospital, and there were 25 tons of medical supply's, including a blood bank. In the Vietnam war, LST 1188 was a test of a ship with complete hospital facility's onboard.

The Navy Hospital ship *Refuge*, for example had 626 beds. The AH-13 *Benevolence* operated in the pacific theater, and returned patients from China to the U.S. In 1947. The USS *Consolation* served in World War-II, and later in Korea.

For the evacuation of the wounded from the D-Day beaches, the British had four Hospital Carriers, mostly re=purposed ferries and coaster steamers.

## **Other Country's Hospital ships**

The U.S. is certainly not the only country to have Hospital Ships.

Brazil has 6. China fields four, India has a converted passenger liner, Indonesia has a former landing craft equipped as a hospital ship. Peru has a hospital ship on Lake Titicaca, the highest navigable lake in the world at 12,500 feet above sea level. Russia has three ships, each with 7 operating rooms, and 100 beds, and Vietnam has one.

The Sovereign Military Order of Malta has its roots in the Crusades, as the Knights Hospitalers, in 1099. The Corps operated its hospital trains during World Wars I and II, and still maintains a 28-car hospital train with 192 beds and a staff of 28 in mainland Europe. It has formal connections with the Red Cross organization.

Rural health is a problem in India, partially addressed by their *Lifeline Express*, a very modern hospital train, operated on the extensive Indian Railways. China has a similar system, using four hospital trains for specialized eye treatment and surgery.

The French have a 5-unit TGV high speed hospital train, deployed in 2019 to offset the Corona Virus pandemic. It is used for transport of patients to hospitals from outlying areas.

The International Charity, *Mercy Ships*, has the largest non-governmental hospital ship fleet in the world. It has covered more than 55 developing country's, and assisted in 18 developed country's in the world. The Charity operates out of Texas, with 16 regional offices around the world. It operates four hospital ships. The *Victoria* was an Italian Ocean Liner, purchased at scrap value. Re-fitted, it is the MV *Anastasis* with 3 operating rooms, and 40 beds. The Norwegian coastal ferry *Polarlys* became the MV *Caribbean Merc*. It focuses on eye surgery. The ex-Canadian Ferry *Petite Forte* was donated to the Charity and became the MV *Good Samaritan*, later, the MV *Island Mercy*. Sister ships *African Mercy* and *Global Mercy* are in construction.

*The AFRICA Mercy* has 5 operating rooms, and 82 beds, as well as X-ray, CT-scan, and a medical lab. Besides treating patients, the ships provide renovation services for hospitals. There is accommodation for 400 crew. The vessel carry's 28 vehicles. All

medical procedures on board are free. The crew also trains local personnel. Most recently, the ship was in Dakar, Senegal.

## **The United States Civil War Hospital Ships**

This section discusses early hospital transport during the American Civil War by ships, horse drawn ambulance, and trains.

At the early battle of Manassas, one of the first major engagements of the Civil War, the Confederate wounded were taken by train to a hospital in Charlottesville, Virginia, taking about 24 hours. The Union had no plans to deal with the number of wounded they sustained. They walked 27 miles to the District of Columbia. Some even survived. It was the American Army's introduction to mass battlefield causality's. Ambulance drivers were just that, drivers, not medics. The first ambulance trains were returning Quartermaster trains, having driven supply's to the front. The boxcars had no windows and no ventilation, and there was no medical staff. This had to be addressed. During the Civil War, Studebaker and other wagon company's built large numbers of ambulances for the Union Army.

At the beginning of the Civil War, there were many organizational problems in the medical organizations of the Army and Navy. A big problem was logistics systems were unprepared for activity's that occurred during the war. The fleet did not have medical and surgical supply's, and inadequate ways to deliver them.

The good news was, by 1864 ships' crews were trained n basic first aid. Also, medical staff were required to keep detailed records and logs.

### **Red Rover**

This hospital ship had a most interesting life. She started out as a

side-wheeler serving with the Confederates. She had been built in 1859 in Missouri and entered service in 1862. She initially served as the barracks ship for the New Orleans floating battery. At New Madrid, Missouri, she was holed by Union cannon fire, and abandoned.

She displaced 660 tons, and was 256 feet long with an 8-foot draught. She could make 8 knots, and was served by a crew of 47.

She was captured by the Union gunboat *Mound City*, and repaired temporarily in March of 1862. She was then fitted out as a hospital ship, and joined the Union Army's Western Flotilla. She served near the front lines, providing medical services and transport for wounded soldiers. She also served to deliver medical supplies to other ships of the flotilla. She had a cold storage locker that could hold 300 tons of ice.

In a reorganization, the *Red Rover* went from the Army, to the Navy. The Army was responsible for boats and ships on inland waterways. Rover had towed barges to isolate contagious cases, such as measles and typhus.

*Red Rover* was converted to a hospital ship at St. Louis and Cairo, Il,. An operating room was built. A full galley was put below decks for crew and patients. Better air circulation on the decks was arranged. A laundry facility was added, with its own steam boiler. Added were an elevator, bathrooms, and gauze window covering, to control cinders from the steam engines. She was ready to go into service in June of 1862. By the 11<sup>th</sup> she had her first patient, David Sans, who had cholera. By the 14<sup>th</sup>, he was joined by 55 others.

On June 17, the USS *Mound City* exploded in action against Confederate battery's in Arkansas. Red Rover went to their aid. One hundred thirty five were injured, most seriously, with extreme burns. They were treated as well as could be on the ship, and transported to hospitals in Illinois.

Red Rover then joined the Western Flotilla at Vicksburg. In September of 1862, she deployed to Cairo, Illinois, for winterization. October 1 marked the transferal of naval assets from

the Army to the Navy. She was the first hospital ship to serve in the U. S. Navy.

Red Rover retained its 32-pounder canon after her conversion, as well as her armor.

The Navy Medical Department of Western Waters was under the command of Fleet Surgeon Edward Gilchrist. The ship had a complement of 47, with 30 medical staff, including three Sisters of the Holy Cross. These were the forerunners of the U.S. Navy Nurse Corps. The Western Sanitation Commission co-ordinated volunteer support. They arranged for the services of two physicians from Boston, Dr. George H. Bixby and Dr. George H. Hopkins. Bixby stayed with the ship throughout the war.

In 1863, she served with the White River expedition at the Port of Arkansas, where she was fired upon. There were no restrictions on this yet, as hospital ships were unique. Two shots entered the hospital.

She served until the Fall of 1864, when she made her last supply run in October. She went up to Mound City, serving as a floating hospital until decommissioned in November 1865. She treated over 2,400 sick and wounded over her career on the rivers. She was later sold at public auction.

In addition to the Navy and Army ships, some State and Private hospitals ships were in service. These included the *Lancaster*, the *Hailman*, the *Marango*, and the *D. A. January*.

The USS *City of Memphis* served as a medical transport ship. Wounded troops went upriver to better medical facility's. Transport ships, however, had little or no medical staff onboard. Those with a contagious disease such as smallpox were towed in barges, fitted with canvas roofs. The Union Hospital Ship *Nashville* was a 1,000 bed floating hospital, but had no engines, and had to be towed.

Hospital ships flew a distinctive yellow flag for identification, and were rarely fired upon.

Overworked military medical personnel were aided by volunteers

from the U. S. Sanitary Commission, and various religious groups. Despite their best efforts, in 1865, more soldiers died from disease than battle.

Early in 1865, in the Carolina Campaign, coastal steamers took the Union wounded from depot hospitals to hospitals in New York City, Alexandria, Va., and Philadelphia. The Hospital Ship *General J. K. Boness*, a coastal steamer, took more than 2,100 wounded to DeCamp General Hospital in New York.

The *City of Memphis* had started out as a luxury gambling boat. The U. S. Sanitary Commission bought the ship and refitted it as a hospital, with 750 beds. In 1862, she carried 10,000 wounded from the fighting in Tennessee to hospitals in Illinois, Ohio, and Missouri. The battle of Shiloh, April 1862, produced 23,000 casualties. The Army and the Navy were not prepared for these numbers.

The Confederate hospital ship *Star of the West* was a steam ship, launched in 1852, and scuttled by Confederate forces in 1863. It was later raised, and served in several uses, including hospital ship.

The data on Confederate Hospital ships is sparse. The CSS *Kanawha Valley* was a re-purposed stern-wheel steamer that burned in April of 1862.

It had originally been built for Cornelius Vanderbilt. She was chartered to the War Department in 1861. She headed out on a resupply mission to Fort Sumter. She was hit several times, some of the first shots in the Civil War. She headed back to New York, and served as a troop transport. Captured by Confederate Galveston militia, she was sent to New Orleans. She served as a hospital ship until New Orleans was captured by Federal forces.

In the Peninsular Campaign, March-May, 1862, There were quite a few amphibious Operations. The campaign was the first major operation for the Sanitary Commission, and their Hospital Transport Service. By May, seven ships were working. Large side-wheel steamers were chartered by the military, and transferred to the Sanitary Commission. They had a capacity of 700 casualties.

The wounded were taken to the Chesapeake Hospital at Fortress Monroe, and hospitals in Philadelphia, Baltimore, and Washington, D. C.

## **U. S. Sanitary Commission**

The U. S. Sanitary Commission, under Executive Director Frederick Law Olmstead, set up a system of hospital ships for the Union during the Civil War. It was a private agency, established in 1861, which operated closely with the Army. It had set up, at the request of the Army, the Hospital Transport Service. It acquired a series of ships, and converted them at its own expense to hospital ships. There were thousands of volunteers, and the Commission had raised around \$25 million dollars, by 1865. It was modeled on the British Sanitary Commission, formed during the Crimean War. The Sanitary Commission operated from the Treasury Building, in Washington, D. C.

The need for these services was demonstrated during the Peninsular Campaign in the Spring of 1862, when it supported causality's from McClellan's 100,000 man Army. The Sanitary Commission had its own fleet of ships for transportation and hospital uses. An entity under the Hospital Commission, the Hospital Transport Service had 16 ships, converted to hospital service. In addition, 5 ships were outfitted by the Commission, and turned over to the Army. These included the *Red Rover*.

## **War in the North**

As the War came to the North, the role of Hospital Ships was reduced. The North had a good train network, and there was less naval action. The hospital ships continued their mission in the South, as the war dragged on there.

At the Battle of Antietam, fought in Maryland, there were 9,420 Federal wounded. Although adjacent to the Potomac River and

C&O Canal, those were not a viable transportation artery. The wounded went by horse drawn ambulance to Frederick, Maryland, population 8,000 which was completely overwhelmed. The citizens took wounded troops into their homes.

From Frederick, the wounded eventually went to hospitals in Washington, Philadelphia, and Baltimore on the B&O Railroad. Washington had six new hospitals constructed in 1862.

The Battle at Gettysburg, called the high water mark of Confederacy forces, produced 33,000 wounded. Of these, 15,000 were evacuated by rail, there being adjacent railroads.

## **Ambulance Trains**

Ambulance trains serve the same purpose as evacuation ships, to transport wounded soldiers from the battlefield to care facility's behind the lines. They generally do not have onboard medical services onboard, except for first aid, and nursing oversight. Some of the more elaborate units did have operating theaters.

The first use of hospital trains occurred during the Crimean War in the 1850's. The British, facing a crisis in supply and health issues, chartered the Grand Crimean Central Railway, which was built by a group of British Railway contractors. It initially carried ammunition and supply's to the front, but was also used to transport wounded soldiers back from the front line to medical facility's. The line was 14 miles in length, with numerous sidings.

Having proven their worth, hospital trains were used during the Franco-Austrian War, the Franco-Prussian War, and the American Civil war. There were very few medical facility's on board as of this time. The rolling stock had painted red crosses to indicate that only wounded and medical staff were onboard. There was, however, no formal prohibition on firing at the cars.

In the American Civil War, the America's first use of trains and ships in hospital duty's was driven by the Civil War. The North had rail, locomotive, and railcar manufacturing. The South did not.

Further, the North used the standard gauge of 4 feet, 8 ½ inches, where the South used the 6 foot gauge. The South's rail had to be imported from England.

The patient cars were originally boxcars, with straw. These were usually carrying supplies to the front, and returning empty. Since there was no passage between cars, patients could not be cared for on the journey. Their approach provided transportation, not treatment. The Quartermasters Corps were responsible for moving the wounded to the rear. The Medical Corps would treat them on arrival, if they had survived the trip.

In October of 1862, the President of the Philadelphia, Wilmington, and Delaware Railroad, constructed and donated new concept cars for carrying the wounded. Passenger cars were modified with upright posts, from which could be slung rubber cords to hold hammocks. This reduced the jostling of the wounded, and the passenger cars had operating windows, and a door at each end to allow medical staff access. These were referred to a *Harris Cars* after their designer, Dr. Harris of the Sanitary Commission.

In 1864, in Georgia, there was a general hospital train, providing medical services, not just transportation. This is somewhat like the MASH units deployed in Korea.

In the Civil War, the author's hometown, Cumberland, Maryland, had ad-hoc military hospitals in Town. There were constant skirmishes along the B&O Railroad & C&O Canal. In addition, there was a major military hospital a few miles west, at Clarysville. This was adjacent to a railroad that served Cumberland, the Eckhart Branch of the Cumberland & Pennsylvania. It was an isolated location, so infectious diseases could be handled. The expert on this facility was my good friend Harold Scott. There is nothing left to see today.

## **Hospital Trains in World War-I**

The role of the trains evolved by World War-1, being more like mobile medical facility's. Over 100,000 British casualties were

evacuated from the battlefields of Flanders in 1914. The trains connected with hospital ships at Channel Ports, for transport back to England. U. S. troops would be sent back on returning troop transports. The ships were painted with Red Crosses, and were lit at night. This protection under the Geneva Convention and International law was generally respected until Germany declared Unrestricted Naval Warfare.

The 1<sup>st</sup>. Sanitary trains of the U. S. Army did not involve locomotives and rails, but had two battalions, a motorized unit and horse drawn unit. Each battalion had two field hospitals and two ambulance units. An Ambulance company had 12 ambulances, with each company having 70 mules, and 24 horses for riding. Each field hospital could handle 236 patients, but had no nurses. The Sanitary train stretched for half a mile on the road, and included 927 officers and men. The First Sanitary Train was attached to the First Expeditionary Division, serving in France.

The hospitals had to deal with chemical casualties as well. Generally, sickness exceeded wounds by a factor of 3 to 1.

In World War-I, hospitals trains were crewed by the Red Cross. They had an operating room, and a trolley system in the cars that allowed a stretcher to be suspended and move along the track. There was also a dormitory car for staff. A lot of States sponsored the cars, and many were donated by the railroads.. Some were repurposed Pullman cars, used for dining cars and dormitory's.

Right after World War-I, returning soldiers brought back the Spanish Flu, causing a massive infection, requiring a massive response. Back home, hospital trains were used to service some remote areas. The Western Maryland Railway had built a hospital train during the war, but it had never been used. It was promptly donated for use in the United States, and was staffed by the Red Cross.

Generally, the hospital trains were ex-military, with Red Cross staff. One did visit the author's home town of Cumberland, Maryland. It was called the *Maryland State Health Train*. There

were seven coaches, hospital cars, nine doctors, and twelve nurses. They met with and trained local doctors, as well as visiting patients at their homes.

Other states had hospital trains as well, including Virginia, Illinois, New Jersey, Illinois, Oklahoma, Kentucky, Arkansas, and Indiana. These were generally staffed by the Red Cross.

In the 1930's the Army's First Medical Regiment, Company G, Hospital unit, deployed to help areas affected by massive on the Mississippi and Ohio Rivers. They had to deal with Typhoid. The First Medical Group is headquartered at Fort Sam Houston, Texas.

The use of hospital trains expanded during World War-II, and the Korean conflict. The U. S.'s *Haven* class of hospital ships served in World War-II, the Korean War, and Vietnam. They were the first ships that were able to receive casualties directly by helicopter. There were six ships of the *Haven* class constructed. The first medical transport by air occurred in World War-II, using a Sikorsky R-4B helicopter in Burma. It could only carry one casualty at a time.

In World War-II, the Army again had a fleet of Hospital Ships, among its fleet of over 125,000 watercraft of all types. About half were amphibious assault craft. State side, the Army had a series of hospital/transport trains that operated out of the Port city's of New York; Charleston, SC; New Orleans, San Francisco, and Hampton Roads, Virginia. There were some 30,000 wounded returning to the U.S. every month. A later U.S. Army Hospital car can be seen at the North Carolina Transportation Museum.

The war in the Pacific was more suited to watercraft ambulances. In the Korean War, the Army operated hospital trains to the port of Pusan. The Army sold off all of its hospital cars in the 1970's, depending more on air transport.

The Medical Units deployed in Operations Desert Shield and Desert Storm were much more ready to directly handle battlefield injury's than their predecessors. They included MASH units as well as Air Ambulance Company's.

Today, the Army's 1<sup>st</sup> Medical Brigade, organized in 1917, is headquartered at Fort Hood, Texas, with hospitals at Fort Polk, Louisiana, Fort Bliss, Texas, and Fort Carson, Colorado.

## Medical Air Transport

With the current low-level conflicts in the middle east, wounded warriors are evacuated by air to Ramstein Air Force Base in southern Germany. From there, they are flown to Joint Base Andrews Air Force Base, outside of Washington, DC. They are picked up by a custom built ambulance, essentially an ICU on wheels. The ambulance takes the patients to the Walter Reed National Military Medical Center, in Bethesda, Maryland. This was formally the Bethesda Naval Hospital. Convention wisdom is, if you make it to Ramstein, you will survive.

The first recorded evacuation by plane goes back to 1917 in the Sinai, when a Royal Air Force plane brought out a wounded soldier from the Royal Camel Corps. The French went on to develop their own air evac group. The U. S. had its Curtis Eagle, a modified biplane intended for the Civilian airliner market. It could handle 2 pilots and 8 passengers. Now, helicopters are mostly used for civilian and military short distance transport, and they can land virtually anywhere. Most major hospitals have helipads.

The French flying military ICU *Morphee* is deployed at this writing to treat COVID-19 patients. They are being moved from overcrowded hospitals to facilities with open beds.

*Morphee* is an acronym in French that means *intensive care module for patients who need long haul evacuation*. The plane has been used five times for military evacuations of wounded French troops from Afghanistan and Kosovo.

The concept and the implementation is not the plane, but a kit that is installed in an aircraft, and can later be removed. This takes several hours. The aircraft can handle 6-12 patients, depending on the complexity of care required. It has all the facilities it needs, including a laboratory. There are two complete kits. These were

initially used in C-135's, but are now used in A330 aircraft. These have a range of 7,400 miles. Only the United States and Britain have this capability, using C-17 Globemasters. The Germans have a similar system for an A310.

Back during the Vietnam war, it took 45 days to return severe cases to the U. S. In Desert Storm in 1991, it was down to 10 days. Survival rates hovered around 75%. Today, the Air Force can do the job in 3 days, from anywhere on the planet. The general saying now is, "if you reach a field hospital with a heart beat, your survival rate is 98%"

The United States has and is using several different aircraft for aero-medical transport. The C-17A is a favorite, as is the older C-5A. They can deliver a complete Army Combat Support Hospital to anywhere in the world. These are then delivered where they are needed by truck, as these are they are a standard modular container configuration. These are the successors to the MASH units, and can have up to 248 beds, with up to 600 staff. The number of beds can vary with the situation, as they are placed in tents. They are accompanied by a ground ambulance company.

The McDonnell Douglas C-17 *Globemaster* has a range in excess of 6,400 miles. A lot of the open deck area is the ward, which can accommodate dozens of stable patients. Entry is from behind, with a large ramp. There is a fully capable operating room. The C-17's capability for in-flight refueling allows for the quickest flight, with no stop-overs.

The plane is in service to various air forces around the world. The planes were first produced in 1971. More than 220 are in service with the U. S. Air Force alone, although most handle logistics flights. As big as it is, it has a crew of 3, 2 pilots and the loadmaster. Besides the medical evacuation role, it can be equipped with a complete hospital. It can handle 36 litter and 54 ambulatory patients, or one Abrams tank.

The U. S. Air Force has a Aeromedical Evacuation Group, flying air ambulances that have a complete ICU. There are 31 squadrons,

some Reserve and some Air National Guard.

## Afterword

The whole idea of using ships, trains, and planes for medical evacuation is to save lives. If the patient can't be easily transported back to the hospital, the hospital will come to them. From the military experience, many civilians have been transported and treated. Many hospital facility's, self-contained and self-sufficient, can be quickly airlifted to the site of natural disasters, and epidemics

In World War-I, 26 hospital ships were attacked deliberately or by mistake. Many lives were lost. In World War-II, 25 Hospital were sunk by torpedo, mines, or air attack. Rest in Peace.

## **Glossary of Terms**

AAMS – Association of Air Medical Service.

AE – air evacuation.

AET - air evacuation technician.

ALS – advanced life support.

BUMED – (U. S. Navy) Bureau of Medicine and Surgery

CCATT – critical care air transport team.

Corpsman – enlisted medical specialist providing first aid, in the Navy.

COVID-19 – circa 2020 Corona virus pandemic.

CSH – combat support hospital.

DANFS – Dictionary of American Naval Fighting Ships.

Dressing Stations – front line facility that stabilizes patients.

EMS – emergency medical services.

FEMA – (U.S.) Federal Emergency Management Agency.

HMMS – (U.K.) His/Her Majesty's Hospital Ship.

ICU – intensive care unit.

Lazaretto – quarantine station.

LST – Landing Ship Tank.

LSTH – Landing Ships Tank, Hospital.

MAC - Military Airlift Command,

MASH - Mobile Army Surgical Hospital.

Medevac – Medical Evacuation.

Medic – Doctor, Medical student.

MSHWR - “Medical and Surgical History of the War of the Rebellion.

MUST – Medical Unit, Self-contained, Transportable.

MV – motorized vehicle, used for ships.

NAS – Naval Air Station

Orderly – assists medical and nursing staff.

Ophthalmic – pertaining to the eye

PA – Physician’s Assistant.

PCRS – (U.K.) Primary Causality Receiving Ship.

PTSD – Post Traumatic Stress syndrome.

RAMC – (U.K.) Royal Army Medical Corps

RN – Registered Nurse.

QAIMNS – (U.K.) Queen Alexandra's Imperial Military Nursing Service.

Quartermaster – supervises supply's and provisions.

RT – respiratory therapist.

TGV – French high-speed train, Train à Grande Vitesse.

Triage – determining the priority of patient treatment.

USAHS – U. S. Army Hospital Ship

USNS – United States Naval Ship.

USSC – United States Sanitary Commission.

VIP – very important person,.

## References

Anonymous, *The War on Hospital Ships, with Narratives of Eyewitnesses, and British and German Diplomatic Correspondence*, 2016, ISBN-978-1371615659.

Arey, Carlyle W. *Air Evacuation and Its Effect on Theater and Zone of Interior Hospitalization Requirements*, 2012, ISBN-978-1288420643.

Barnes, Joseph K. *The Medical and Surgical History of the War of the Rebellion. (1861-65). Prepared, in Accordance with the Acts of Congress, Under the Direction of ... K. Barnes, United States Army; Volume I*, 2016, ISBN-978-1371092474.

Barton, Clara, *A Story of the Red Cross Glimpses of Field Work*, 2011, ASIN-198507088X.

Behling, Laura *Hospital Transports: A Memoir of the Embarkation of the Sick and Wounded from the Peninsula of Virginia in the Summer of 1862*, 2005, ISBN-978-0791463697.

Bollett, Alfred Jay *Civil War Medicine: Challenges and Triumphs*, 1917, ASIN-B01N0USC9N.

Boyle, Robert & Son, *Ventilation Of The Smallpox Hospital Ship 'Castalia'*, 2015, ISBN-978-1298858610.

Brooke, Rupert, *Rupert Brooke's Death and Burial: Based on the Log of the French Hospital Ship Duguay-Trouin*, 2016, ISBN-978-1371479558.

Bucklin, Sophronia E. *In Hospital and Camp in the American Civil War*, 2014, ASIN-B00MG26BJO.

Clark, M.D. Howard, "American Hospital Trains in France,"

Medical times, Vol. XLVI, 1918.

Copeland, Jeffrey S. *Lt. Elsie Ott's Top Secret Mission: The WWII Flight Nurse Pioneer of Aeromedical Evacuation (MEDEVAC)*, 2020, ISBN-978-1557789419.

Department of Defense (U. S.) *Tactical Combat Casualty Care and Wound Treatment*, 2015, ASIN-B00YNW21JO.

Dolzan, Rhonda, *WWI, No 1 Australian Hospital Ship*, 2016, ASIN:B01MS8XFNI

Fatherly, Sarah "Tending the Army, Women and the British General Hospital in North America 1754-1763," Queens University of Charlotte (South Carolina), Fall 2012, McNeil Center for Early American Studies.

Fisher, W. Douglas *African American Doctors of World War I: The Lives of 104 Volunteer*, 2015, ISBN-978-1476663159.

Flemming, John A., Mills, Simon, *The Last Voyage of His Majesty's Hospital Ship Britannica*, 1995, ISBN-978-1899493029.

Foltz, Charles Steinman *Surgeon of the seas;: The adventurous life of Surgeon General Jonathan M. Foltz in the days of wooden ships*, 1931, ASIN-B00085M8HU.

Foreman, Jacob *Western Sanitary Commission: A Sketch of Its Origin, History, Labors for the Sick and Wounded of the Western Armies, and Aid given to Freedmen and with Incidents of Hospital Life (Civil War)*, reprint 2009, ISBN-978-1429015653.

Gabriel, Richard A. *The Official US Army Combat Medic Manual & Trainer's Guide*, 2017, ISBN-978-1975929398.

Gabriel, Richard A. *Between Flesh and Steel: A History of Military Medicine from the Middle Ages to the War in Afghanistan*, 2013,

ISBN-978-1612344201.

Grunawalt, Richard J. *Hospital Ships in the War on Terror: Sanctuaries or Targets*, 2012, ISBN-978-1288333462.

Hall, A. Kendall, *The War on Hospital Ships, with Narratives of Eye Witnesses*, 2016, ASIN-B01M7Q7B1X.

Harper, Dale P, *Too Close for Comfort*, 2006, ISBN-978-1552126288.

Harris, Robert P. *The Flight Nurse Bible: A Field Guide To Awesomeness*, 2018, ASIN- B07KKH82WX.

Helling, M. D., Thomas *Desperate Surgery in the Pacific War: Doctors and Damage Control for American Wounded, 1941-1945*, ISBN-978-1476664217.

Herman, Jan K. *Navy Medicine in Vietnam: Oral Histories from Dien Bien Phu to the Fall of Saigon*, 2009, ASIN - 978-1476675282

Hill, Howard “363d Field Hospital Co., 316th Sanitary Train, 91st Division, U. S. A., 2019, ISBN- 978-0267852116.

Hooker, Richard *MASH: A Novel about Three Army Doctors*, 1968, ASIN- B0014H326C.

Horner, G. R. B. *Diseases and Injuries of Seamen: with Remarks on Their enlistment, Naval Hygiene, and the duties of Medical Officers*, 1854. avail: <https://hdl.handle.net/2027/chi.47702465>.

Jenkins, Leo *Lest We Forget: A Ranger Medic's Story*, 2017, ASIN-B076B4ZB4F.

Lane, LCDR David A. USN, *Hospital Ship Doctrine in the United States Navy: The Halsey Effect on Scoop-and-Sail Tactics*, Military Medicine, 162, 6:388, 1997.

Larson, Harold *Army Hospital Ships in World War II*, 2014, ISBN-978-1497360006.

Lauderdale, John Vance, *The Wounded River: The Civil War Letters of John Vance Lauderdale, M.D.*, 2012, ASIN-B00LN0D1IY.

Luard, Kate; Oarsons, Mark *The Ambulance Trains and Hospital Barges of France-World War I*, Illustrated, 2012, ASIN-B00A0QLMSS.

Magister, Marcus *The First Hospital Ship & Other Innovations in Federal Naval Medicine During the U.S. Civil War*, 2019, avail: <https://medium.com/@marcusmagister>.

Makros, Michele *Love Letters from the Marine Wolf: A US Hospital and Transport Ship, an Army Medic Afloat, and a War Bride in World War II*, 2019, ISBN-978-1524689841

Massman, Emory A. *Hospital Ships of World War II: An Illustrated Reference*, 1999, ISBN-978-0786405565.

McGreal, Stephen *War on Hospital Ships 1914-1918*, 2009, ISBN-978-1844158584.

McCutcheon, Campbell *Hospital Ships & Troop Transport of the First World War*, 2015, ISBN-978-1445638676.

Neal, Jr. Larry K. "Railroads Carry Wounded Soldiers, Hospital Cars Rode the Rails," Tar Heel Junior Historian.

Olmsted, Frederick Law, *Hospital Transports: A memoir of the Embarkation of the Sick and Wounded from the Peninsula of Virginia in the Summer of 1862*, 2019, ASIN-B0827SDDXL.

Otis, George *A Report on a Plan for Transporting Wounded*

*Soldiers by Railway in Time of War*, 1875, (U. S.) War Department, Surgeon General's Office, reprint 2010, ISBN-978-1164546061.

Pike, John “World Wide Hospital Ships,” avail: <https://www.globalsecurity.org/military/world/hospital-ships.htm>

Plumridge, John H. *Hospital Ships and Ambulance Trains*, 1974, ISBN-978-0854220878.

Puzzilla, Anthony G. *Hospital Trains and Vessels during the Civil War: The Evolution in the Handling and Transportation of the Wounded*, 2020, ASIN-B084Z1X61B.

Roca, Steven Louis, *Presence and Precedents: The USS Red Rover during the American Civil War, 1861-1865*, 1998, Civil War History, Vol. 44, No. 2, avail: <https://www.questia.com/library/>

Rushton, Patricia *Gulf War Nurses: Personal Accounts of 14 Americans, 1990–1991 and 2003–2010*, 2010, ISBN-978-0786460731.

Scott, Harold L. *The Civil War hospitals at Cumberland & Clarysville, Maryland*, 1995, ASIN-B0006F5BH6.

Smith, Barry, “Bringing Them Home: U. S. Airforce Aeromedical Evacuation,” 2020, avail: <https://www.emsworld.com/321142>.

Spar, M. D., Ira *Civil War Hospital Newspapers: Histories and Excerpts of Nine Union Publications*, 2017, ISBN-978-1476665603.

Steel, Charles *Fifty Thousand Miles on a Hospital Ship*, 2016, ISBN-978-1362276210

Stephens, Lynda Rutledge; Stephenson, Don, *Ships of Mercy: Bringing Hope & Healing to the World's Forgotten Poor* - Revised and Expanded Edition, 2012, ISBN-978-0986028434.

Stille, Charles J, *History of the United States Sanitary Commission: Being the General Report of Its Work During the War of the Rebellion*, 2018, ASIN-B07CLK2HFN.

Sutherland Shaw, J.J. (1936). "The Hospital Ship, 1608–1740". *The Mariner's Mirror*. 22 (4): 422–426 Avail: <https://www.tandfonline.com/doi/abs/10.1080/00253359.1936.10657206>.

Whitman, Walt , *Memoranda During the War: Civil War Journals, 1863-1865*, reprint 2010, ASIN-B007Z0WK88.

Woolman, Jack *Hospital Ship: Memories of HMHS Tjitjalengka During World War II*, 2001, ISBN-978-1858581972 .

Wormeley, Katharine Prescott, *The Other Side of War: 1862*, reprint 2014, ASIN- B00NIVPNB4.

## Resources

History of U. S. Navy Hospital Ship Red Rover, U. S. Navy Historical Division, Ships' Histories Section, 1961, avail: Internet Archive.

WW2 Hospital Ships,

avail:[https://web.archive.org/web/20110726132246/http://www.med-dept.com/hosp\\_ships.php](https://web.archive.org/web/20110726132246/http://www.med-dept.com/hosp_ships.php)

U. S. Army Hospital Ships in WWII, avail:  
<https://www.scribd.com/document/33217726/WWII-1944-Hospital-Ships-History>

*The Story of Air Evacuation*, 1942-1989, Taylor Publishing Co., ASIN-B000IDTOLA.

<https://www.wired.com/2015/01/military-airplane-hospital/>

<https://www.airspacemag.com/military-aviation/the-flying-emergency-room-31127647/>

<https://www.businessinsider.com/coronavirus-german-military-airbus-a-310-medevac-coronavirus-italy-germany-2020-3>

<https://www.wired.com/2015/01/military-airplane-hospital/>

“Medavac From Luzon,” avail:  
<https://www.airspacemag.com/military-aviation/medevac-from-luzon-187256/>

<https://www.wired.com/2015/01/military-airplane-hospital/>

Stille, Charles “History of the United States Sanitary Commission, Being the General Report of Its Work during the War of the Rebellion,”

1866, avail:

<https://archive.org/details/historyofuniteds00stiluoft/page/n4/mode/2up>

Popular Mechanics, State's (Maryland) Hospital Train Ready for War Service," August 1917, p. 173.

"Report of the Adjutant General of the State of Maryland, State of Maryland Hospital Train," p. 57

Mention of the Maryland Hospital Train in the N.A.R.D (National Association of Retail Druggists) Journal, p. 164, Vol 24, Issue 4, 1917. avail: Google Books.

"Hospital Trains in the (Boer) War" Royal Engineering Journal, Vol 11, No. 1, July 1905, avail: <https://wellcomelibrary.org/item/b1953419x>

Civil War Ambulance Wagons" [www.civilwarhome.com](http://www.civilwarhome.com).

Navy Department, Office of the Chief of Naval Operations, Division of Naval History, Ships' History Section, "History of U. S. Hospital Ship Red Rover, available on Internet Archive.

Comission (sic) of U. S. Navy's First Hospital Ship, U.S. Naval Institute, Dec. 26, 2011, avail:

<https://www.navalhistory.org/2011/12/26/comission-of-u-s-navys-first-hospital-ship>

Kleuius, Mike "The Flying Emergency Room, Military Aviation, Air & Space Magazine," Nov. 2012.

"State Health Train Here to Flight Plague," Cumberland Evening Times, Oct 12, 1918. avail:

<https://newspaperarchive.com/advertisement-clipping-oct-12-1918-1707813>.

Wikipedia, various

## **If you enjoyed this book, you might also be interested in some of these.**

Stakem, Patrick H. 16-bit Microprocessors, History and Architecture, 2013 PRRB Publishing, ISBN-1520210922.

Stakem, Patrick H. 4- and 8-bit Microprocessors, Architecture and History, 2013, PRRB Publishing, ISBN-152021572X,

Stakem, Patrick H. Apollo's Computers, 2014, PRRB Publishing, ISBN-1520215800.

Stakem, Patrick H. The Architecture and Applications of the ARM Microprocessors, 2013, PRRB Publishing, ISBN-1520215843.

Stakem, Patrick H. Earth Rovers: for Exploration and Environmental Monitoring, 2014, PRRB Publishing, ISBN-152021586X.

Stakem, Patrick H. Embedded Computer Systems, Volume 1, Introduction and Architecture, 2013, PRRB Publishing, ISBN-1520215959.

Stakem, Patrick H. The History of Spacecraft Computers from the V-2 to the Space Station, 2013, PRRB Publishing, ISBN-1520216181.

Stakem, Patrick H. Floating Point Computation, 2013, PRRB Publishing, ISBN-152021619X.

Stakem, Patrick H. Architecture of Massively Parallel Microprocessor Systems, 2011, PRRB Publishing, ISBN-1520250061.

Stakem, Patrick H. Multicore Computer Architecture, 2014, PRRB Publishing, ISBN-1520241372.

Stakem, Patrick H. Personal Robots, 2014, PRRB Publishing, ISBN-1520216254.

Stakem, Patrick H. RISC Microprocessors, History and Overview, 2013, PRRB Publishing, ISBN-1520216289.

Stakem, Patrick H. Robots and Telerobots in Space Applications, 2011, PRRB Publishing, ISBN-1520210361.

Stakem, Patrick H. The Saturn Rocket and the Pegasus Missions, 1965, 2013, PRRB Publishing, ISBN-1520209916.

Stakem, Patrick H. Microprocessors in Space, 2011, PRRB Publishing, ISBN-1520216343.

Stakem, Patrick H. Computer Virtualization and the Cloud, 2013, PRRB Publishing, ISBN-152021636X.

Stakem, Patrick H. What's the Worst That Could Happen? Bad Assumptions, Ignorance, Failures and Screw-ups in Engineering Projects, 2014, PRRB Publishing, ISBN-1520207166.

Stakem, Patrick H. Computer Architecture & Programming of the Intel x86 Family, 2013, PRRB Publishing, ISBN-1520263724.

Stakem, Patrick H. The Hardware and Software Architecture of the Transputer, 2011, PRRB Publishing, ISBN-152020681X.

Stakem, Patrick H. Mainframes, Computing on Big Iron, 2015, PRRB Publishing, ISBN- 1520216459.

Stakem, Patrick H. Spacecraft Control Centers, 2015, PRRB Publishing, ISBN-1520200617.

Stakem, Patrick H. Embedded in Space, 2015, PRRB Publishing, ISBN-1520215916.

Stakem, Patrick H. A Practitioner's Guide to RISC Microprocessor Architecture, Wiley-Interscience, 1996, ISBN 0471130184.

Stakem, Patrick H. Cubesat Engineering, PRRB Publishing, 2017, ISBN-1520754019.

Stakem, Patrick H. Cubesat Operations, PRRB Publishing, 2017, ISBN-152076717X.

Stakem, Patrick H. Interplanetary Cubesats, PRRB Publishing, 2017, ISBN-1520766173 .

Stakem, Patrick H. Cubesat Constellations, Clusters, and Swarms, Stakem, PRRB Publishing, 2017, ISBN-1520767544.

Stakem, Patrick H. Graphics Processing Units, an overview, 2017, PRRB Publishing, ISBN-1520879695.

Stakem, Patrick H. Intel Embedded and the Arduino-101, 2017, PRRB Publishing, ISBN-1520879296.

Stakem, Patrick H. Orbital Debris, the problem and the mitigation, 2018, PRRB Publishing, ISBN-1980466483.

Stakem, Patrick H. Manufacturing in Space, 2018, PRRB Publishing, ISBN-1977076041.

Stakem, Patrick H., NASA's Ships and Planes, 2018, PRRB Publishing, ISBN-1977076823.

Stakem, Patrick H. Space Tourism, 2018, PRRB Publishing, ISBN-1977073506.

Stakem, Patrick H. STEM – Data Storage and Communications, 2018, PRRB Publishing, ISBN-1977073115.

Stakem, Patrick H. In-Space Robotic Repair and Servicing, 2018, PRRB Publishing, ISBN-1980478236.

Stakem, Patrick H. Introducing Weather in the pre-K to 12 Curricula, A Resource Guide for Educators, 2017, PRRB Publishing, ISBN-1980638241.

Stakem, Patrick H. Introducing Astronomy in the pre-K to 12 Curricula, A Resource Guide for Educators, 2017, PRRB Publishing, ISBN-198104065X.

Also available in a Brazilian Portuguese edition, ISBN-1983106127.

Stakem, Patrick H. Deep Space Gateways, the Moon and Beyond, 2017, PRRB Publishing, ISBN-1973465701.

Stakem, Patrick H. Crewed Spacecraft, 2017, PRRB Publishing, ISBN-1549992406.

Stakem, Patrick H. Rocketplanes to Spacecraft, 2017, PRRB Publishing, ISBN-1549992589.

Stakem, Patrick H. Crewed Space Stations, 2017, PRRB Publishing, ISBN-1549992228.

Stakem, Patrick H. ,Enviro-bots for STEM: Using Robotics in the pre-K to 12 Curricula, A Resource Guide for Educators, 2017, PRRB Publishing, ISBN-1549656619.

Stakem, Patrick H. STEM-Sat, Using Cubesats in the pre-K to 12 Curricula, A Resource Guide for Educators, 2017, ISBN-1549656376.

Stakem, Patrick H. Visiting the NASA Centers, and Locations of Historic Rockets and Spacecraft, 2107, PRRB Publishing, ISBN-154965120X.

Stakem, Patrick H. Lunar Orbital Platform-Gateway, 2018, PRRB Publishing, ISBN-1980498628.

Stakem, Patrick H. Embedded GPU's, 2018, PRRB Publishing, ISBN- 1980476497.

Stakem, Patrick H. Mobile Cloud Robotics, 2018, PRRB Publishing, ISBN- 1980488088

Stakem, Patrick H. Extreme Environment Embedded Systems 2017, PRRB Publishing, ISBN-1520215967.

Stakem, Patrick H. What's the Worst, Volume-2, 2018, ISBN-1981005579.

Stakem, Patrick H., Spaceports, 2018, ISBN-1981022287.

Stakem, Patrick H., Space Launch Vehicles, 2018, ISBN-1983071773.

Stakem, Patrick H. Mars, 2018, ISBN-1983116902.

Stakem, Patrick H. X-86, 40th Anniversary ed, 2018, ISBN-1983189405.

Stakem, Patrick H. Exploration of the Gas Giants and the Ice Giants, Space Missions to Jupiter, Saturn, Uranus, and Neptune, 2017, ISBN-1717814506.

Stakem, Patrick H. Rocket Science-101, 2018, ISBN-1977067697.

Stakem, Patrick H. Lunar Orbiting Platform-Gateway, 2017, ISBN-1980498628.

Stakem, Patrick H. Space Weather, 2018, ISBN-1723904023.

Stakem, Patrick H. STEM-Engineering Process, 2017, ISBN-1983196517.

Stakem, Patrick H. RISC-V in Space, 2019, ISBN-1796434388 .

Stakem, Patrick H. Mars Railroad, 2019, ISBN–1794488243.

Stakem, Patrick H. Arm in Space, 2019, ISBN-1099789133.

Stakem, Patrick H. Exploiting the Moon, ISBN-978-1091057852.

Stakem, Patrick H. Terraforming, 2018, ISBN-978-1790308101.

Stakem, Patrick H. Exploration of the Asteroid Belt, a new approach, 2018, ISBN-978-1731049841.

Stakem, Patrick H. Exoplanets, 2018, ISBN-978-1731385055.

Stakem, Patrick H. Planetary Defense, 2018, ISBN-978-1731001207.

Stakem, Patrick H. Space Telescopes, 2018, ISBN-978-1728728568.

#### 2019 Releases

Stakem, Patrick H. Submarine Launched Ballistic missiles, ISBN-978-1088954904.

Stakem, Patrick H., Space Command, Military in Space, ISBN-978-1693005398.

#### 2020 Releases

Riverine Ironclads, Submarines, and Aircraft Carriers of the American Civil War

Robotic Exploration of the Icy moons of the Gas Giants.

Hacking Cubesats.

History & Future of Cubesats.

Exploration of Lunar & Martian Lava Tubes by Cube-X

Online Teaching & Learning